

Long-term Monitoring and Analysis of Carbonate System in Coral Reef

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Anthropogenic activity of fossil fuel burning increases the carbon dioxide concentration in the atmosphere, and then affect the carbonate system in the ocean through interaction among atmosphere, ocean and biosphere.

Coral reef is a highly productive tropical-subtropical ecosystem, however, which may be affected by the modification of carbonate system. Long-term monitoring of carbonate system in coral reef will reveal the role of increase in anthropogenic CO₂ on the coastal natural ecosystem.

Monitoring of carbonate system has been carried out since 2000 on the coastal coral reef at Sesoko Station. pH, DO, salinity and temperature(YSI Sonde), as well as water depth and current(COMPACT-EM), were monitored every 15 minutes, and alkalinity was measured twice in a week(TIM860 Titrator). pCO₂, and organic and inorganic carbon productions were obtained from carbonate system analysis. Air-sea CO₂ flux also obtained from wind-dependent equation. Precise measurements of carbonate system components such as alkalinity, total inorganic carbon, pH, pCO₂ (NDIR LICOR6262 with gas permeable equilibrator) and air-sea CO₂ flux (NDIR LICOR 810 with chamber) were carried seasonally. Continuous precise monitoring of alkalinity and total inorganic carbon in sea water(KIMOTO ALK-01) also employed with every 30 minutes since 2006.

1) Diurnal variation of pCO₂ was clearly obtained, however the maximal values and the time of the day vary with lapse of time.

2) Seasonal variation pCO₂ with high values in summer and low in winter, which may be caused by the variations of temperature and biological activity with season.

3) Diurnal and seasonal variations of air-sea CO₂ flux were observed, which is dependent of the pCO₂ value, temperature and wind speed. CO₂ was absorbed in sea water from December to February, however released into air after the February. Occasional increase in CO₂ flux was observed during the period of typhoon.

4) The yearly budget of air-sea CO₂ flux shows CO₂ release from sea water to the air by 1034 mmol/m²/y, of which 30% is caused by typhoon season.

5) Frequency analysis of pCO₂ showed that pCO₂, as well as carbonate system and more generally chemical environments, is controlled mainly by both solar and lunar cycles, which may be modified by the increased in anthropogenic pCO₂ with lapse of time.